Then the wind catches in the leaves and flowers and bends the stems and branches, so that the flowers are most conspicuous on the same side. I have seen the heads of Helianthus grosse-serratus turned to the northeast by a southwest wind, and the bees were flying southwest, and thus approached the heads in front. But the flower-stalks often whip about, making it hard for an insect to light. It must be tantalizing to a bee for the head to fly up and leave her suspended in mid-air.

In Physostegia the flowers are nearly sessile, so that they are not easily shaken by the wind, and when turned to any position remain in it. Prof. W. W. Bailey says:[2] "The flowers are made to assume their definite position by friction of the pedicels against the subtending bracts. Remove the bracts and they at once fall limp. This was shown me by Prof. Goodale in 1879." With the breath one can easily blow the flowers to the opposite side of the spike.

Prof. Coulter[3] has observed how the movement of the flowers is useful in bad weather by turning their mouths from a driving rain, but I think it is also advantageous in fair weather in adaptation to the flight of insects.

In September, 1886, I found several hundred stalks of Physostegia Virginiana arranged in a long patch along the railroad. The southwest wind was blowing up the road, and the flowers were all turned away from the wind, so that they looked to the northeast. As I walked through the patch from the southwest, I passed nineteen humble-bees, Bombus Pennsylvanicus[4] (females and workers), all going against the wind, except two, which did not visit the flowers regularly but flew away to the northeast. Returning, I overtook the bees going against the wind, but passed none going with it. Keeping their faces to the wind, they would move from side to side, or even let themselves back to a spike they were about to leave behind. It was interesting to observe that, while the wind required the bees to face it, it compensated for the disadvantage by carrying the odors to them and by turning the flowers so that they were more easily seen and visited by them.—CHARLES ROBERTSON, *Carlinville, Ill.*

Conditions of Assimilation.[5]—In this paper Dr. Pringsheim notes the limitations of the prevalent method of gas analysis, and has striven by direct observation of the protoplasm to determine the seat and relations of the various functions. It seemed likely that the observation of protoplasmic movements in varying conditions of light and darkness, and in partial or total removal of oxygen, would afford a suitable starting

[2] BOT. GAZ. vii, 122.

[3] BOT. GAZETTE, vii, 111.

[4] The flowers are also visited by Apathus elatus (frequent) and Colias Philodice (once).

[5] Dr N. Pringsheim has communicated to the Prussian Academy of Sciences a preliminary account of his researches on the dependence of assimilation in green cells on the presence of oxygen and on the locality where the oxygen formed in assimilation actually originates. These researches are so important that we present the following abstract by Prof. A. W. Bennett, from the *Jour. Roy. Mic. Soc., Dec.*, 1887, p. 992 —[EDS.

point for his researches. Previous experiments had forcibly suggested that observed differences in the assimilative energy did not in any way depend on differences in the number of chlorophyll-bodies, or on the abundance of chlorophyll within these, but on the oxygen respiration of the protoplasm. This point Pringsheim sought further to investigate.

It has been long known that the green cells can break up CO_2 in the absence of oxygen, where the CO_2 is mixed with some innocuous gas. It is also known that protoplasmic movement is dependent on the presence of oxygen. If this be so, the protoplasmic movement in a green assimilating cell, in a medium free from oxygen, should not come to a stand-still as long as it is illuminated, and the conditions of carbonic dioxide analysis fulfilled. With these facts in view, Pringsheim tried by experiment to answer the question whether a plant normally assimilating would cease to assimilate, without any alteration of its chlorophyll relations, if it were deprived, even for a short time, of the oxygen which is essential for respiration and plasmic movement, and whether it would recommence to assimilate whenever fresh oxygen was supplied. His experiments answered this in the affirmative.

The naked terminal cells of Chara leaves were placed in suspended drops in a microscopic gas chamber; oxygen was, as far as possible, excluded, a continuous stream of CO_2 and hydrogen passed through, and the amount of light caused to vary. In darkness the rotation of the protoplasm gradually ceases, the length of time before stoppage varying with the degree to which oxygen is successfully excluded, with the specific nature of the cell, and with the mass of protoplasm. The final result is a state of complete "asphyxia," when the cell is dead, though still normal morphologically. If the cells be taken just before asphyxia, just when the protoplasm is ceasing to move at all, it will be found that they are no longer able to assimilate. They are still quite normal; but if now placed in an illuminated chamber, and supplied as before with carbonic acid, the rotation will not return. A little free oxygen restores the original state; but without this, in spite of the presence of light, chlorophyll and CO_2, no oxygen is formed. This state Pringsheim calls "inanition" or "Ernährungs-ohnmacht." What has been noted in regard to its occurrence goes to show the dependence of assimilation on the absorption of oxygen.

But it is also a fact that the same phenomena of inanition occur when cells in similar circumstances are kept continuously in the light. Repeating the above experiment with continuous illumination instead of darkness, Pringsheim again observed the stoppage of rotation, and with it the cessation of the liberation of oxygen. The absence of free oxygen is again the condition of the cessation of function; if a small quantity be introduced the life revives, at least if inanition has not gone too far.

How is this to be explained in terms of the generally accepted theory of assimilation? *If the disruption of carbonic dioxide within the cell furnishes oxygen directly*, how can any assimilating cell suffer from want of oxygen? Pringsheim does not admit the usual assumption italicized above. His opinion is that the analysis of the CO_2 in assimilation does *not* directly furnish oxygen, but that some other substance is formed, which, passing diosmotically to the surface, breaks up and liberates free oxygen. He criticises the usual arguments based on the results of gas analysis. What the substance is which forms oxygen at the surface he is not prepared to state.

If this be so, the breaking up of CO_2 and the liberation of O are two processes, distinct both in space and time, the one occurring within the cell, the other at its surface. This view is supported by reference to the peculiar liberation of oxygen exhibited in darkness by both green and unpigmented cells toward death. The bacterium-method proves this fact incontestably. This liberation of oxygen in darkness, quite independent of contemporaneous assimilation, may be termed "intramolecular liberation of oxygen," and, according to Pringsheim, the normal liberation is an essentially similar process, resulting from the disruption of an exosmosing substance.

He advances other arguments to show that we are not warranted in concluding, as has hitherto been done, that the presence of light, chlorophyll and CO_2 exhausts the conditions of assimilation, and that in estimating its amount no other factors but light-energy and the absorption of light by the chlorophyll have to be taken into account. Assimilation is, on the contrary, a physiological function of the protoplasm, and, like movement, depends on the presence of free oxygen. Physiologists will look with interest for Pringsheim's detailed account of his investigations on this important subject.

The proposed Botanical Exchange Club.—The committee appointed by the Botanical Club of the A. A. A. S. at the New York meeting to act for the club in the formation of a Botanical Exchange, after considerable correspondence and the consultation of the rules and regulations of similar organizations abroad, is now in a position to submit to the members of the club certain tentative propositions, on which individual opinion is solicited.

The regulations of the Botanical Exchange Club of the British Isles, published in pamphlet form at Manchester in 1886, seem applicable to our needs, with certain necessary modifications. In order to bring these before the botanists of the country, a synopsis of them is here presented, arranged with reference to America instead of Great Britain.

1. The object of the club will be to facilitate the exchange of herbarium specimens of American plants, specially of rare species and varieties. The conditions of membership to be that each member shall furnish a parcel of specimens annually, and pay a yearly subscription of a